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Intelligence Memorandum

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The Soviet Aluminum Industry:

Increasing Dependence on Foreign Raw Materials

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
November 1971

INTELLIGENCE MEMORANDUM

THE SOVIET ALUMINUM INDUSTRY:
INCREASING DEPENDENCE ON FOREIGN RAW MATERIALS

Introduction

1. During the past ten years there has been a strong and sustained effort in the USSR to create a large aluminum industry. Ambitious goals for the output of aluminum were set during the Seven-Year Plan period (1959-65) and during the Eighth Five-Year Plan period (1966-70). Despite shortfalls from those planned goals, the Soviet aluminum industry, nevertheless, achieved impressive increases in output of aluminum ingot and has become one of the world's leading producers and exporters of this metal.

2. More recently it has become apparent that the drive to expand output very rapidly has outstripped the capacity of domestic raw materials producers. Hence, the USSR has been forced to accelerate imports of bauxite and alumina from foreign suppliers. The United States, in particular, has suddenly become a major supplier of alumina to the USSR.

3. This memorandum assesses the implications of the Soviet drive to expand its purchases of raw materials from non-Soviet suppliers and reviews some of the key problems affecting the past and future development of the aluminum industry.

Discussion

Background

4. The USSR is the second largest producer of aluminum in the world. Output in 1970 amounted to an estimated 1.7 million metric tons⁽¹⁾

1. All tonnages are metric.

Note: This memorandum was prepared by the Office of Economic Research and coordinated within CIA.

(see Table 1), about 48% of the level of US output and about one-fifth of world production.⁽²⁾ During the decade 1961-70, output nearly tripled, and the growth rate of aluminum exceeded that of any other major non-ferrous metal.

Table 1

USSR: Production of Primary Aluminum a/

<u>Year</u>	<u>Production (Thousand Metric Tons)</u>	<u>Index (1960 = 100)</u>	<u>Percent Increase</u>
1960	630	100	--
1961	700	111	11
1962	770	122	10
1963	855	136	11
1964	945	150	11
1965	1,000	159	6
1966	1,160	184	16
1967	1,295	206	12
1968	1,475	234	14
1969	1,595	253	8
1970	1,720	273	8

a. Output of secondary aluminum (scrap recovery) is not included in this table.

2. For a discussion of how estimates were derived, see the Appendix.

5. The rapid growth in aluminum output is the result of policy decisions made more than a decade ago. Those decisions were reflected in the very high output targets set for the Seven-Year Plan (1959-65), and for the Eighth Five-Year Plan (1966-70). Output was planned to triple during the Seven-Year Plan and more than double during the Eighth Five-Year Plan. Actual output, however, fell short of planned goals in both periods by a substantial margin: in 1965 an estimated 1 million tons of aluminum were produced against the 1.5 million tons planned; in 1970, actual output reached about 1.7 million tons, compared with a planned goal of 2 million tons.

6. During the current Five-Year Plan period, output is planned to grow at the rate of 8%-10% a year, somewhat below rates achieved during the 1960s, but still rapid. If planned goals are realized, the USSR will raise annual production by about 1 million tons of aluminum during 1971-75 and reach a level of output of 2.8 million tons by 1975. In 1975, output of aluminum in the USSR could exceed more than one-half of the US level.

Big Push in Siberia

7. The steady growth in aluminum production in recent years is the result of an extensive program of modernization and expansion of plant capacity. Since about 1964, new aluminum reduction facilities (smelters) have been built, or are under construction, at Irkutsk, Krasnoyarsk, and Bratsk in Eastern Siberia, at Novokuznetsk (North) in Western Siberia, and at Volgograd in the Western USSR. The plants in Eastern Siberia are very large; when full capacity is reached, these facilities will provide 1.5 million tons of aluminum ingot a year, an amount nearly equal to the output of all Soviet producers in 1970 (see Table 2). Eastern Siberia has emerged as the major center of aluminum production in the USSR.

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8. The smelters in Eastern Siberia are far removed from the major centers of aluminum consumption in the Western USSR. Moreover, at the present time it is necessary to supply these smelters with most of their raw materials (alumina)⁽³⁾ from plants in the Urals about 2,900 kilometers distant.⁽⁴⁾ Freight charges associated with these increased transportation

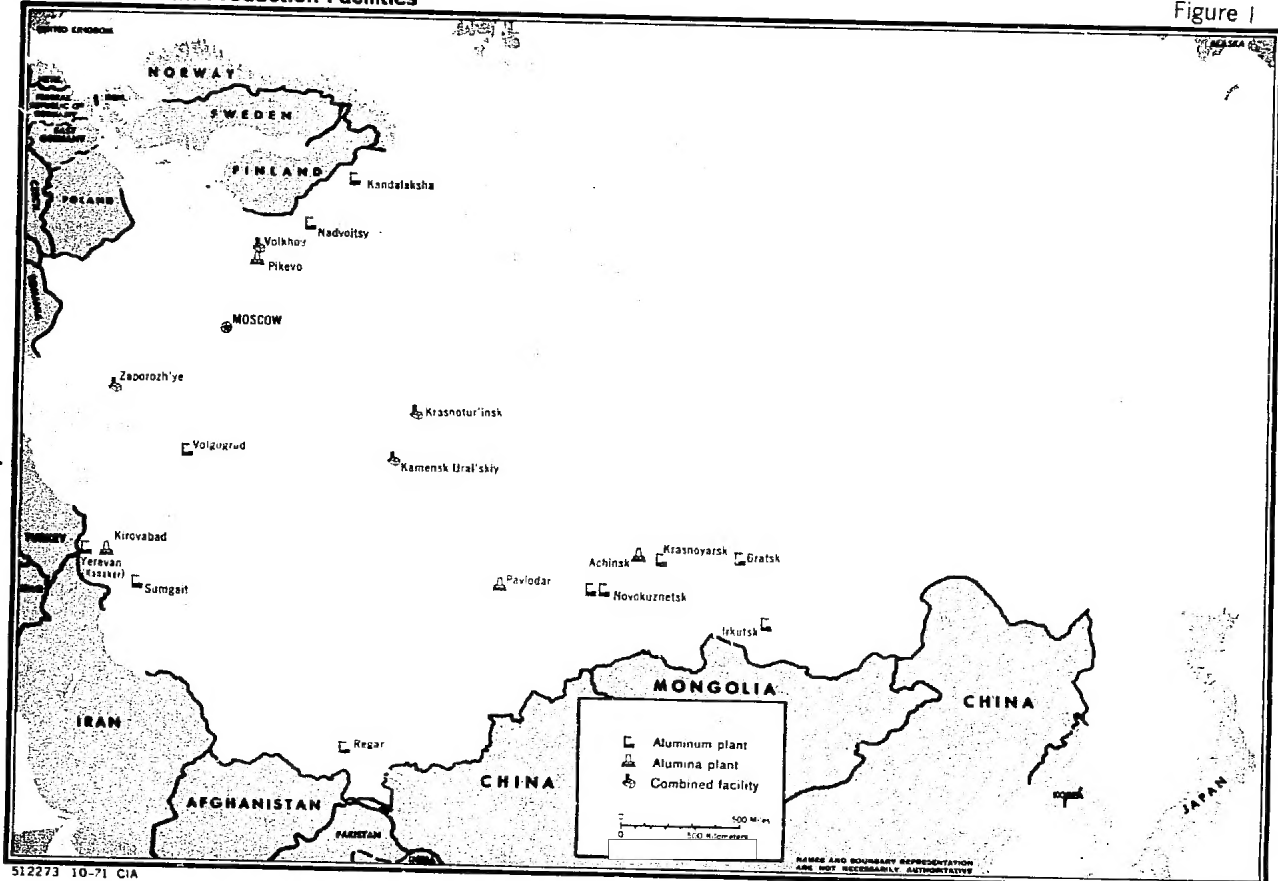
3. *Alumina (aluminum oxide) is an intermediate product derived from bauxite and other aluminous ores. Alumina is processed into aluminum at reduction plants.*

4. *At Kamensk-Uralskiy and Krasnoturinsk.*

Soviet Aluminum Production Facilities

Figure 1

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Table 2

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USSR: Actual and Planned Capacity
of Soviet Aluminum Reduction Plants
1970

<u>Plant</u>	<u>Capacity (Thousand Metric Tons)</u>	<u>Planned Additions (Thousand Metric Tons)</u>
<u>Western USSR</u>		
Kamensk-Uralskiy	100	--
Kanaker	35	--
Kandalaksha	75	--
Krasnoturinsk	100	--
Nadvoitsy	60	--
Sumgait	60	--
Volgograd	280	--
Volkhov	20	--
Zaporozh'ye	100	--
<u>Western Siberia</u>		
Novokuznetsk (North)	160	--
Novokuznetsk (South)	80	--
<u>Eastern Siberia</u>		
Bratsk	300	420
Irkutsk	180	210
Krasnoyarsk	240	120
<u>Central Asia</u>		
Regar	Unknown	Unknown
<i>Total</i>	<i>1,790</i>	<i>750</i>

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requirements add an estimated 40-50 rubles to the cost of each ton of aluminum produced in Eastern Siberia, compared with the cost of producing aluminum in the Urals region or in the Western USSR. Nevertheless, these costs are acceptable because of the significant savings in operating costs that are realized in Eastern Siberia by the use of very cheap hydroelectric power (aluminum smelters consume enormous quantities of electric power). For example, the cost of electric power per ton of aluminum in Eastern Siberia is about 35 rubles compared with about 70 rubles in the Western USSR and about 145 rubles in the Urals region.⁽⁵⁾ Thus, it may be seen that even with the increased transport charges, the unit cost of producing aluminum in Eastern Siberia is lower than in the Urals and compares very favorably with costs in the Western USSR.⁽⁶⁾ Moreover, the cost savings of the Eastern Siberian smelters will be enhanced over the next few years as plants in the Urals begin to phase down as primary suppliers of alumina. The USSR plans to supply most of the alumina needs of the new smelters in Siberia from two large new alumina plants that have been under construction in Pavlodar in the Kazakh SSR and Achinsk in Eastern Siberia [REDACTED].⁽⁷⁾ Construction of these facilities has been stretched out far beyond completion dates, and production is currently far below design levels.

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9. The decision of the Soviet government to locate aluminum smelters in Eastern Siberia, although justified by the relatively low costs of electric power, probably was not based exclusively on considerations of the cost advantages. It seems likely that this decision reflects a longer range Soviet economic strategy designed to develop the mineral and industrial potential of Eastern Siberia.

Impetus to Growth

10. The Soviet aluminum industry is being developed mainly to support the current and future needs of the Soviet defense and aerospace industries. About 70% of all output is consumed internally and the lion's share of this amount is believed to go to aerospace applications, both civil

5. *The cost of electric power per kilowatt-hour (kw/hr) in kopecks for these regions is: Eastern Siberia, 0.2; Western USSR, 0.4; Urals, 0.8. In general, 18,000 kw/hr are consumed in the production of one ton of aluminum.*

6. *Labor costs are higher in Siberia, but since these plants are highly automated, the higher labor costs do not significantly alter these comparisons.*

7. *A third plant has been constructed in Kirovabad (Azerbaijani SSR) to supply alumina to plants in the Western USSR.*

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and military. According to official Soviet sources, the aircraft industry is the largest single consumer of aluminum mill products.⁽⁸⁾

11. Another major consumer of aluminum is the Soviet electro-technical industry. Considerable progress has been made in the use of aluminum, as a substitute for copper, in electro-technical products such as transformers and power transmission cables. About two-thirds of all power cables produced in the USSR in 1970 used aluminum conductors, and this proportion is scheduled to increase in the future. But other sectors of the economy, such as the consumer goods and construction industries which are major consumers of aluminum in the United States, have not been important consumers in the USSR. In 1970 the domestic consumption of aluminum in the USSR was only about one-third that of the United States. With civilian applications lagging and domestic consumption below potential levels, the USSR throughout the 1960s has had substantial quantities of aluminum available for export, and the USSR has become one of the world's leading exporters of aluminum.

Exports

12. Exports, however, are directed mainly to the Communist countries of Eastern Europe – principally East Germany and Czechoslovakia. Of the 500,000 tons of aluminum ingot and rolled products exported in 1970, about 75% went to the other Communist countries, principally Eastern Europe. Exports of aluminum to these Communist countries have been growing at rates of about 20% annually. In all, such exports increased from about 60,000 tons in 1960 to 370,000 tons in 1970 (see Table 3).

13. The USSR has not achieved any significant penetration in the non-Communist aluminum market. The year 1970 was the peak year thus far for Soviet sales of aluminum, most going to Japan and the United Kingdom. Still, sales in the non-Communist market represented only about 1% of the supply available on that market.

14. The volume of Soviet exports to non-Communist countries has been limited since 1963 by the so-called "Gentlemen's Agreement" which is in effect between the Soviets and major aluminum producers in Japan and Western Europe. Under this agreement, producers purchase a mutually agreed upon quantity of aluminum from the USSR annually (more than

8. *The Ministry of the Aviation Industry, not the Ministry of Nonferrous Metals, appears to have control over the fabrication of aluminum mill products. It is not known if this control extends to mill products manufactured in special fabricating sections of aluminum smelters.*

Table 3

USSR: Exports of Aluminum Ingot
and Rolled Products

				Metric Tons
<u>Year</u>	<u>Total</u>	<u>Communist Countries</u>	<u>Non-Communist Countries</u>	<u>Unidentified</u> ✓
1960	77,100	57,134	16,903	3,063
1961	99,500	79,455	16,503	3,542
1962	137,100	89,661	39,921	7,518
1963	147,800	96,573	38,933	12,294
1964	209,300	128,764	55,381	25,155
1965	271,100	161,961	70,494	38,645
1966	310,500	182,675	108,038	19,787
1967	313,500	208,832	86,673	17,995
1968	367,100	291,493	65,200	10,407
1969	422,800	322,529	90,700	9,571
1970	499,900	370,685	86,968	42,247

a. By far, the largest part of unidentified shipments are exported to non-Communist countries.

100,000 tons in 1970). In turn, the USSR agrees to market its aluminum in Europe and Japan through the major producers. Direct Soviet sales of primary aluminum ingot to smaller aluminum producers in Western Europe and Japan that are not parties to the agreement are forbidden. The purpose of the agreement is to prevent disruption of the aluminum market by Soviet "dumping". Participating producers purchase aluminum from the USSR usually at prices 10%-12% below prevailing prices.

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Squeeze on Raw Materials

15. Traditionally, the USSR has enjoyed, and continues to enjoy, a larger measure of self-sufficiency in raw materials (bauxite and other ores) for the aluminum industry than any other major world producer of aluminum. Since the mid-1960s, however, domestic output of raw materials and alumina has failed to keep pace with the rapid growth in aluminum output. For example, in 1960 domestic raw materials provided for an estimated 85% of aluminum production; by 1970 this share had fallen to about 65%.⁽⁹⁾ Thus it has become necessary to import substantial quantities of raw materials.

16. The output of raw materials has lagged behind the needs of the aluminum industry for two major reasons: high-quality bauxite is in short supply, and the production of alumina from non-bauxite ores is behind schedule. The Soviets claim to have large reserves of bauxite, and have recently intensified prospecting, but the alumina content of undeveloped deposits is generally low (about 40%), and many of the deposits are not favorably located for economic exploitation.⁽¹⁰⁾ Further, most Soviet bauxite ores contain large amounts of silicon and titanium which increase the cost of processing. Long-established mines in the Urals are the principal sources of high-quality bauxite, but reserves of these deposits appear to be nearing exhaustion after almost 40 years of continuous exploitation. The Soviets are now exploiting ores of much lower quality in the Urals. Supplies of high-quality bauxite can be stretched out by blending with lower quality ores. However, wide variations in the quality of the ores makes it difficult to obtain a uniform blend required by the alumina plants for efficient operations. Such difficulties have hampered operations at the large alumina plant at Pavlodar⁽¹¹⁾ which is estimated to be operating well below its rated capacity (500,000 tons).

17. The USSR recognized some years ago that reserves of high-quality bauxite probably would prove inadequate for the long-term needs of the aluminum industry. Provision was made for extensive use of other aluminous ores, such as nepheline syenite and alunite. Technology was developed and successfully employed as early as 1948 for the production of alumina from nepheline syenite at two small plants at Pikolevo and Volkhov in the Western USSR. In 1956, plans were drawn up for construction at Achinsk (near

9. It is estimated that the USSR produced about 1.2 million tons of alumina from domestic ores in 1960 and about 2.2 million tons in 1970. Approximately 2 tons of alumina are required to produce 1 ton of aluminum.

10. High-grade bauxite is generally considered to have an alumina content of about 50% or more.

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Krasnoyarsk) of a large alumina plant to exploit local nepheline syenite ores (25% alumina content). Construction was not begun until 1964, however, and by 1970 the plant was still only in partial operation. The delays in completion of this facility are probably attributable, in part, to the severe climatic conditions of the zone in which the plant is being built. In addition, difficulties probably were experienced in developing techniques for the large-scale processing of nepheline ores. The scale of operations envisioned at Achinsk (800,000 tons per year) has no counterpart elsewhere in the world. Technical difficulties probably also explain the delay encountered in reaching full production at the Kirovabad alumina plant. This plant produces alumina from alunite, a non-bauxite ore with 18% alumina content. Although the plant was put into operation in 1965, it has still not achieved the planned output of 250,000 tons of alumina per year, according to recent statements of the Minister of the Ministry of Nonferrous Metals.

18. To ensure an adequate future supply of raw materials, the Soviets have been experimenting for many years with a process of direct reduction - that is, the production of aluminum directly from aluminous clay - primarily kyanite and kaolin - eliminating the intermediate alumina production phase. Reportedly, this technology will reduce new investment costs by about 20% and production costs by about 7%. A pilot plant, using direct reduction techniques, is now in operation at Zaporozh'ye producing about 50,000 tons of aluminum annually. Two additional direct reduction plants may ultimately be built at Irkutsk, but information on planned dates of completion and design capacity is not available.

19. Aluminum produced in the USSR from aluminous clay by direct reduction contains a relatively high amount of silicon and titanium impurities. Hence, applications of this aluminum are limited at present to alloy castings of the kind used largely in the automotive industry for the manufacture of engine blocks and transmission housings. As the technology of direct reduction is improved, the purity of the aluminum will also improve, permitting a broader range of uses in the future. If commercial-scale levels of output of high-quality aluminum by this process can be achieved, the Soviet aluminum industry will ensure a high degree of self-sufficiency in aluminum production and greatly enhance its reputation as a world technological leader.

Growing Dependence on Foreign Suppliers

20. The growing Soviet dependence on foreign sources for aluminous raw materials is evidenced by the fact that in 1970 about 35% of the total

output of aluminum was accounted for by imports of alumina and bauxite, compared with about 14% in 1965. Prior to 1965, only Greece, which had been shipping about 400,000 tons of bauxite yearly to the USSR, was an important non-Soviet source of supply. Since 1965, imports of both bauxite and alumina have increased dramatically. Yugoslavia joined Greece as a major supplier of bauxite. Imports from Yugoslavia jumped almost six-fold during 1966-70 and in 1970 accounted for more than 50% of the 1.5 million tons of bauxite imported by the USSR in that year. Small amounts of bauxite were also obtained from Guinea.

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21. Even more noteworthy has been the growth in trade in raw materials with the United States. US exports of alumina to the USSR mushroomed from slightly more than 50,000 tons in 1967, the first year ever that the United States exported alumina to the USSR, to about 300,000 tons in 1970 – nearly a five-fold expansion in exports in a three-year period. Such exports may reach about 500,000 tons in 1971. Hungary also has become a major exporter of alumina to the USSR (about 200,000 tons in 1970) as part of a long-term agreement for the exchange of Hungarian alumina for Soviet aluminum. Small amounts of alumina also has been obtained from Greece, Guinea, Jamaica, Surinam, and France (see Table 4). Japan also shipped 125,000 tons of alumina to the USSR in the first half of 1971.

Prospects

22. If the current Five-Year Plan goals are met, output of aluminum will increase by 50%-60% and reach a level of 2.5 million-2.8 million tons by 1975. Most of the estimated additional increment of 800,000-1,100,000 tons of aluminum will come from existing facilities. Completion of the aluminum smelters in Eastern Siberia (Bratsk, Irkutsk, and Krasnoyarsk) and operation of these plants at full capacity will yield an additional 750,000 tons of output. The remaining tonnages needed to meet the planned goal could result from the completion of a new plant which is currently under construction at Regar in the Tadzhik SSR and modernization of some of the older plants.

23. The projected increase in aluminum production is certain to strain the capacity of domestic raw material supplies. The USSR may be able to increase alumina production by about 1 million tons by 1975, as the plants at Achinsk, Pavlodar, and Kirovabad near full production. This amount, however, falls far short of the additional 2 million tons of alumina needed to sustain the increased aluminum output. Consequently, the USSR will continue to require large additional imports of bauxite and alumina. The Soviets have been shopping in various countries for long-term contracts to ensure ample supplies of raw materials in future years. A recently

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Table 4
USSR: Imports of Bauxite and Alumina, by Country

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	Thousand Metric Tons										
	Bauxite										
<i>Total</i>	428.8	455.0	308.3	441.3	449.3	604.8	787.2	1,076.7	1,232.7	1,400.2	1,547.6
Greece	428.8	455.0	308.3	441.3	449.3	481.0	426.9	430.1	456.6	525.5	615.0
Yugoslavia	--	--	--	--	--	123.8	360.3	646.6	721.3	826.7	813.7
Guinea	--	--	--	--	--	--	--	--	54.8	44.1	118.9
	Alumina										
<i>Total</i>	--	--	--	--	15.1	--	--	167.5	387.5	711.8	517.6 ^{a/}
France	--	--	--	--	--	--	--	--	18.0	29.0	N.A.
Greece	--	--	--	--	--	--	--	21.9	28.1	38.2	N.A.
Guinea	--	--	--	--	--	--	--	--	--	5.0	--
Hungary	--	--	--	--	--	--	--	89.4	147.9	169.2	201.5
Jamaica	--	--	--	--	15.1	--	--	--	--	--	--
Surinam	--	--	--	--	--	--	--	--	--	116.0	N.A.
United States	--	--	--	--	--	--	--	53.2	193.5	354.4	291.4
Yugoslavia	--	--	--	--	--	--	--	3.0	--	--	--
Unidentified	--	--	--	--	--	--	--	--	--	--	24.7

a. Additional purchases of alumina were made but are unreported.

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concluded 30-year trade agreement with Guinea provides for shipments of about 2 million tons of bauxite annually to the USSR beginning in 1974. Alumina shipments from Hungary are scheduled to increase in the future and will reach 330,000 tons annually by 1980. Alumina shipments from the United States are also likely to remain at substantial levels during the next several years. The Soviets recently signed a contract with a large US firm for 200,000 tons of alumina annually through 1975. The USSR is also actively seeking to obtain long-term contracts for bauxite with Australia and Indonesia. Barring any major turn-around in domestic raw material production, it is estimated that imports of bauxite and alumina will account for more than 50% of aluminum production in 1975.

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24. The USSR will require about 5.5 million tons of alumina equivalent to meet the 1975 target; about 2.7 million tons must come from foreign suppliers. It is estimated that about two-thirds of these imports (1.8 million tons) will be purchased from non-Communist countries. However, it appears that current suppliers of alumina and bauxite may not be able to wholly cover this amount. In that event, the USSR will be forced to find new sources of supply in Australia, Indonesia, or possibly Guyana. Since the recent nationalization of Alcan's holdings, Guyana has had difficulty finding markets for 1 million-2 million tons of high-quality bauxite and would be a ready source of additional supply for the Soviets.

25. The substantial transport costs involved in shipping alumina to the East Siberian smelters from the Urals will remain an added cost to the Soviet aluminum industry for the foreseeable future. The plants at Achinsk and Pavlodar, even at full capacity, will produce only about 60% of the projected raw material needs of the East Siberian plants by 1975. Further delays in construction at Pavlodar and Achinsk could aggravate the supply situation and necessitate even longer shipments of alumina from plants in the Ukraine.

26. Soviet exports of aluminum will continue to increase in the next five years and may reach 700,000-800,000 tons by 1975. Most of these exports will continue to go to Eastern Europe, especially East Germany, Czechoslovakia, and Hungary. It does not appear likely that the USSR will be able to achieve any significant penetration of non-Communist markets. Recent information indicates that under the terms of the "Gentlemen's Agreement," aluminum producers outside the Soviet orbit will increase their purchases of aluminum from the USSR by an additional 10,000 tons annually during the next five years. Moreover, the planned increases in aluminum production throughout the world during 1971-75 are likely to keep pace with demand and further reduce the likelihood of any significant increases in Soviet sales.

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27. The USSR has assigned a key role to aluminum in the future development of the economy and is promoting new domestic uses of the metal. The projected high rate of growth in the engineering and construction industries combined with a renewed emphasis on substitution of light metals for traditional heavy metals is likely to increase the demand for aluminum. In his speech to the 24th Party Congress, for example, A.N. Kosygin referred to the need to increase the use of modern light-weight aluminum components in construction in place of traditional building materials. Some evidence is available to indicate that the USSR is taking some of the necessary steps to succeed in promoting new uses of this metal. For example, specialized fabricating plants that produce aluminum structural components are now under construction at Voronezh in the Ukrainian SSR and at Khabarovsk in the Far East. The Voronezh plant is scheduled for completion in 1973 and will process 200,000 tons of aluminum annually. Numerous reports also indicate that the fabricating sections of the Bratsk, Sumgait, Kandalaksha, and Irkutsk plants are being enlarged to increase production of a variety of aluminum wire and cable products.

Conclusions

28. The USSR is the world's second largest producer of aluminum. Output nearly tripled during the 1960s, and another large increase in production is scheduled for 1971-75. The region of Eastern Siberia has become the major center of aluminum production and will remain so for the foreseeable future.

29. The Siberian smelters are far removed from major centers of aluminum consumption and sources of raw materials. Substantial transport costs are incurred in shipping alumina to the smelters from the Urals and returning aluminum ingot to the Western USSR. However, the added freight costs are more than offset by the large cost savings achieved by using cheap Siberian hydroelectric power. It is believed that the decision to locate aluminum smelters in Eastern Siberia was not based on considerations of profitability alone but is part of a broader long-range strategy to develop the industrial potential of this region.

30. The rapid increase in aluminum production has outstripped the production of raw materials by a wide margin, forcing the USSR to step up imports of bauxite and alumina. Soviet dependence on foreign suppliers of raw materials increased substantially during the late 1960s, and this trend is likely to continue, perhaps even to accelerate, during the next five years.

31. The large increase in production of aluminum scheduled for 1971-75 is intended primarily for the domestic economy. Efforts to promote new uses of aluminum probably will meet with some success in view of the progress being made in the construction of facilities designed to expand and diversify the output of aluminum products. A further increase in exports also seems likely, with most of these exports continuing to go to Communist countries. Exports to non-Communist countries probably will increase modestly but will continue to account for only a small share of their supply.

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